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**Robert A. Blecker**

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RESEARCH INSTITUTE**

Gordon Hall  
418 North Pleasant Street  
Amherst, MA 01002

Phone: 413.545.6355  
Fax: 413.577.0261  
[peri@econs.umass.edu](mailto:peri@econs.umass.edu)  
[www.peri.umass.edu](http://www.peri.umass.edu)

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# External Shocks, Structural Change, and Economic Growth in Mexico, 1979–2006

ROBERT A. BLECKER\*

*Department of Economics  
American University  
Washington, DC 20016 USA,  
e-mail: blecker@american.edu*

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**Summary.** — This paper estimates the effects of external constraints on growth and investment in the Mexican economy, and how those effects have changed since the economic liberalization of the 1980s and the formation of NAFTA in 1994. Shocks to net financial inflows, world oil prices, the U.S. growth rate, and the real value of the peso explain most of the fluctuations in Mexico's annual growth since 1979 (with structural breaks in some of these effects due to liberalization or NAFTA). Both Hausman weak exogeneity tests and simultaneous equations estimates generally support the view that growth drives investment but not the other way around, in the short run. Inflows of foreign direct investment have positive effects on investment, but the coefficients are small and their statistical significance is marginal.

*JEL Classifications* — O54, O11, E22, F43

*Key words* — Mexican economy, external shocks, economic growth, investment function, financial inflows, real exchange rates

# External Shocks, Structural Change, and Economic Growth in Mexico, 1979–2006

## 1. INTRODUCTION

The Mexican economy in the first decade of the twenty-first century presents a fascinating paradox. On the one hand, the country appears to have achieved the macroeconomic stability that eluded it during the last three decades of the twentieth century. The extreme boom-bust cycles that plagued Mexico between the 1970s and the mid-1990s have not reoccurred since the recovery from the peso crisis of 1994–95. Since 2003, the inflation rate has been below 5% per year, while the current account deficit has been held to about 1% of gross domestic product (GDP) or less.<sup>1</sup> On the other hand, Mexico's growth has been disappointing for most of the period since the liberalizing reforms of the late 1980s and the country's entry into the North American Free Trade Agreement (NAFTA) in 1994. The late Victor Urquidi, one of Mexico's greatest economists, lamented in one of his last articles that "Mexico has been in a state of social and economic stagnation for the last two decades" (2003, p. 561). The growth rate of real GDP averaged 2.8% per year during the period 1981–2006, compared with 6.4% in 1951–80.<sup>2</sup>

The academic literature has debated many explanations for the persistently slow growth of the Mexican economy since the 1980s.<sup>3</sup> Much of the literature has emphasized a variety of internal obstacles, such as the lack of fiscal reform, depressed public investment spending, and deficiencies in the rule of law. Some studies have focused on supply-side problems such as the low rate of total factor productivity growth, although other studies contend that the latter is a symptom rather than a cause of slow output growth. The existing literature also recognizes that

Mexico operates under a number of well-known external constraints, including fluctuating world prices for export products (principally oil and labor-intensive manufactures), the growth rate of the U.S. economy (Mexico's main export market), liberalized international flows of trade and investment, and competition from other emerging market nations (especially China).

This paper focuses exclusively on fluctuations in Mexico's growth during the years since the country first opened up to the global economy by promoting oil exports and borrowing from international capital markets at the end of the 1970s. This choice of time period is determined partly by data constraints, and partly by a desire to focus on a period during which external constraints or "shocks" can reasonably be hypothesized to have been of decisive importance. Since we use data for the period 1979–2006, our analysis cannot address the question of why *average* growth has been slower during this period than it was during the previous three decades. Regression models, by their nature, can only explain the *deviations* of the dependent variable from its sample mean—not the mean itself. Nevertheless, the results in this paper shed light on the principal determinants of the wide fluctuations in the growth of the Mexican economy *during* the recent decades of slower average growth. Given the enormous volatility of annual Mexican growth during this period, an analysis that explains these fluctuations should have important implications for what is presently constraining the growth of the Mexican economy.

The central contention of this paper is that external constraints or "shocks" have played a predominant role in determining the growth rate of the Mexican economy throughout our sample period. Our econometric results show that Mexican growth has been tightly constrained by four key "external" variables: net financial inflows, defined as the sum of current transfers plus the financial account balance (excluding official reserve asset transactions) in the balance of payments; the growth rate of the U.S. economy; the world real price of oil; and the (lagged) real

value of the Mexican peso, taken as a measure of external competitiveness (the lagged value of the peso is used to avoid endogeneity problems and for other reasons discussed below).

According to structural break tests, the effects of three of these four variables have changed significantly since the liberalizing reforms of the late 1980s and the formation of NAFTA in 1994, but all four continue to explain most of the variations in Mexican growth up to 2006.

Furthermore, our estimates of a more complete model including an investment function suggest that the low rate of investment in Mexico since the 1980s is an effect, and not a cause, of the low rate of growth of output in the short run. Using simultaneous equations estimation methods, we find that the GDP growth rate has a strong and significant “accelerator” effect on the investment rate, but (after controlling for the external shock variables) the domestic investment rate has no statistically significant “multiplier” effect on the GDP growth rate. This finding is also confirmed by Hausman weak exogeneity tests. We also estimate the effects of other variables, including the real interest rate, real exchange rate, real oil prices, and foreign direct investment (FDI), on domestic investment in Mexico. Most interestingly, although FDI inflows are found have a positive effect on overall investment, the estimated effects are not statistically significant in all equations, and the small coefficients (usually about 0.2) suggest that FDI has largely substituted for domestic investment.

The rest of the paper is organized as follows: Section 2 surveys the existing literature on Mexican growth and external constraints. Section 3 presents the data set. Section 4 discusses the econometric estimates of the growth model, while section 5 covers the estimates of the investment function (both using single equation methods). Section 6 then considers a variety of estimates using simultaneous equations methods. Section 7 presents simulations of the impact of the various external shock factors on the growth and investment rates. Section 8 concludes.

## 2. LITERATURE SURVEY

Studies of external constraints on Mexico's growth and the effects of international shocks were commonplace in the aftermath of the debt crisis of the 1980s and the peso crisis of 1994–95. For example, Zedillo (1986)—who was later President of Mexico in 1994–2000—conducted a decomposition and simulation analysis of the effects of external shocks and domestic policies on Mexico's balance of payments in the 1970s and 1980s. Ros (1987) emphasized how external shocks in oil prices and interest rates, combined with sudden reversals of capital flows, precipitated the 1982 debt crisis—and how external constraints contributed to the difficulties of the post-crisis recovery. Lustig & Ros (1993) discussed Mexico's efforts to reverse the outward resource transfers that had depressed the economy in the 1980s through measures such as the Brady debt relief plan of 1989 as well as structural reforms that were intended to bolster investors' confidence. Prior to the 1994–95 crisis, some observers were already worried about the appreciation of the peso impeding export-led growth (e.g., Dornbusch & Werner, 1994). After the peso crisis, some analysts focused on the earlier overvaluation of the peso (e.g., Dornbusch et al., 1995), while others stressed the financial panic that broke out after the government abandoned its exchange rate peg (e.g., Sachs et al., 1996; Calvo & Mendoza, 1996). López Gallardo et al. (2006) applied Minsky's theory of financial fragility to the volatility of financial inflows into Mexico during the 1994–95 crisis.

Several studies have highlighted the conflict between Mexico's macroeconomic stabilization policies, which have frequently led to appreciation of the peso, and the country's

reliance on exports to promote growth in the post-liberalization era.<sup>4</sup> Alejandro Nadal aptly explains this conflict as follows:

Mexico's new economic strategy has thus far been unable to achieve economic growth accompanied by external equilibrium. There are many reasons for this situation, but the core explanation is closely related to a stabilization process that accords high priority to the struggle against inflation. This strategy, in turn, has relied heavily on a relatively restrictive stance on monetary and fiscal matters, as well as an overvalued exchange rate. This has led to high interest rates that have stifled growth and damaged Mexico's external position.... Overreliance on the exchange rate to reduce inflation leads inexorably to a worsening of the trade balance, and it therefore runs counter to an essential component of the open-economy model. (Nadal, 2003, pp. 57–59.)

Ramírez de la O (2004, pp. 84–85) concurs, arguing that high interest rates in Mexico in the late 1990s and early 2000s led to appreciation of the peso, and suggests that “currency appreciation may have gone too far in hurting long-term investment.”

A related issue that has received much attention is the disjuncture between the rapid growth of Mexican manufactured exports after the liberalization of trade in the late 1980s and the persistently slow growth of GDP since that time. One widely noted cause is the fact that many of the country's export industries have become so heavily import-dependent that they generate few “backward linkages” to the domestic economy (see, e.g., Ruiz-Nápoles, 2004). This problem is most obvious in the maquiladora sector, in which imported parts and components account for about three-quarters of the value of exports,<sup>5</sup> but it is increasingly true in the manufacturing sector as whole. Moreno-Brid et al. (2005, p. 1098) stress that, after the opening of the economy in the late 1980s, “few policies [were put] in place to efficiently promote exports,” and those that were implemented generally lacked adequate funding or were focused mainly on tax breaks for imported inputs.

Some economists have argued that Mexico has to restrain the growth of domestic demand (e.g., through contractionary fiscal and monetary policies) in order to prevent rising imports from

leading to a large trade deficit, and that this need for restraint has increased since Mexico opened its economy (see, e.g., Ros, 1995; Moreno-Brid, 1998; Pacheco-López & Thirlwall, 2004).

Moreno-Brid (1999, 2002) and Pacheco-López (2005) found that Mexico experienced an increase in the income elasticity of its demand for imports after the trade liberalization of the 1980s, thus reducing the growth rate consistent with balanced trade for any given rate of export expansion. Pacheco-López (2005) also found that the trade liberalization policies of the 1980s increased the long-run growth rates of both exports and imports, but NAFTA increased only the growth rate of imports.<sup>6</sup> According to Pacheco-López & Thirlwall (2004) and Pacheco-López (2005), Mexican exports are highly elastic with respect to U.S. income in the short run.

Only a few studies have identified precise mechanisms through which macroeconomic policies have restrained growth in the more recent period. Galindo & Ros (2008) identify a bias toward appreciation of the peso in the operation of Mexican monetary policy since the recovery from the peso crisis. They find that, between 1995 and 2004, the Banco de México followed an asymmetrical policy in which it usually tightened monetary policy when the peso depreciated, but did not relax monetary policy when the peso appreciated (except in the second half of 2003, when the peso was allowed to depreciate from a severely overvalued level). With regard to fiscal policy, Ros (2006) discusses the procyclical bias in a fiscal policy that is targeted on the fiscal balance itself. This forces the government to cut back expenditures during economic downturns, when a countercyclical fiscal stimulus is needed, and also when oil prices are low (since the state-owned oil monopoly is a major source of government revenue).

A few previous studies have estimated econometric models that directly test for the causes of Mexico's slow growth or low investment rate during the recent period. Ibarra (2006) estimates several components of a short-run macroeconomic model of the Mexican economy,



including equations for investment, saving, the profit share, and the growth of manufactured exports. Among other things, he finds that the real value of the peso has a negative effect on the profit share of value added (especially in tradable goods sectors), and that this in turn discourages real fixed investment since the latter is a positive function of the profit share. Most of Ibarra's econometric estimates are confined to annual data for the period 1989 (or 1990) to 2005, due to data limitations as well as a desire to focus on "the post-trade liberalization period" (2006, p. 15n8).<sup>7</sup> Ibarra's results need to be interpreted with caution due to the short sample periods and lack of attention to possible simultaneity among the various equations.<sup>8</sup>

Galindo & Ros (2008) use cointegration analysis for a model (with quarterly data from 1982:1 to 2003:4) that includes four variables: Mexican output, Mexican investment, U.S. output, and the real exchange rate (defined as the relative price of foreign goods, so that a higher real exchange rate indicates a depreciation). After finding at least one significant cointegrating vector, the authors interpret the first cointegrating vector as an equation for Mexican output. This equation implies positive "long-run" effects of the other three variables on Mexican output. However, in the impulse responses only the effects of U.S. output and Mexican investment are positive, while the effect of the real exchange rate is initially negative (significantly so for the first six quarters) and does not turn positive even after ten quarters. These results must be interpreted with caution, because investment is likely to be an endogenous variable, and hence this equation could incorporate other causal relationships between the variables (e.g., effects of output on investment rather than the reverse).

Galindo & Ros (2008) also report cointegration results for split samples before and after NAFTA went into effect in 1994. These results show a notably greater positive effect of real peso depreciation on output in 1994:1 to 2003:4 compared with 1982:1 to 1993:4, but only a

slightly greater effect of U.S. output on Mexican output in the post-NAFTA period. However, cointegration analysis conducted over such short time periods must be interpreted with even greater caution. In contrast, several studies using other methodologies have found large and significant increases in the “synchronization” of Mexican output and industrial production with U.S. business cycles since NAFTA (see, e.g., Chiquiar & Ramos-Francia, 2004; Lederman et al., 2005, pp. 91-92; Mejía Reyes, et al., 2006). The results in this paper, presented below, support a significantly greater effect of U.S. growth, not the exchange rate, on Mexican growth after 1994.

In regard to longer-term obstacles to growth, many studies have argued that Mexico’s failure to complete its own internal reform agenda has prevented the country from taking advantage of the opportunities afforded by the opening to international trade and the deregulation of domestic markets (see, e.g., Hufbauer & Schott, 2005; Studer & Wise, 2007). Areas that are frequently cited as needing reform include the tax system (which relies too much on oil revenue), the energy sector (which is dominated by the state-owned energy monopoly PEMEX), the rule of law, competition policy, and reducing the cost of doing business in Mexico. These authors generally attribute the lack of reform to the political gridlock in Mexico’s chaotic, fledgling democracy, where no party has had a majority in the Congress since 1997. However, Guerrero et al. (2006) argue that the inability to move forward on reform is the result of deeper “structures of inequality and institutions”—i.e., highly concentrated wealth in the business sector and the corporatist social institutions created by the former ruling party—that result in suboptimal political outcomes. Also, some analysts have noted that the economic integration process under NAFTA is “shallow,” in the sense that it does not include the institutional framework, development assistance, and convergence policies that were adopted in the formation of the European Union (see, e.g., Pastor, 2001; Weintraub, 2004; Studer & Wise, 2007).

Analyses using a neoclassical growth accounting framework generally find that total factor productivity (TFP) growth in Mexico fell beginning in the early 1980s—in fact, a typical finding is that TFP growth was negative between 1980 and 2003.<sup>9</sup> However, some economists have questioned whether the fall in TFP growth is a consequence rather than a cause of the long-term growth slowdown. Moreno-Brid & Ros (2009) argue that standard TFP estimates are misleading because of changes in labor force participation rates and occupational structures. In their view, “the deterioration in the productivity growth performance of the Mexican economy since 1980 has to be seen as an endogenous consequence of the sluggish [rate of] economic expansion,” which made the formal economy incapable of absorbing the rapidly growing labor force and pushed increasing numbers of workers into low-productivity, informal service activities.<sup>10</sup> Several studies have focused instead on the low overall investment rate since the debt crisis of the 1980s (e.g., Moreno-Brid & Ros, 2004; Ibarra, 2006). Máttar et al. (2003) note that the recovery of investment in manufacturing in the 1990s was concentrated in a few export-oriented sectors dominated by foreign companies, leading to an industrial structure focused on the transformation or assembly of imported inputs with weak linkages to the domestic economy.

The more long-term oriented studies thus raise important structural issues, but do not address the specific constraints that have been most binding on the Mexican economy in the short run during the period of slower average growth since the 1980s. Some studies have focused on various particular constraints during this period, such as the conflict between the use of the exchange rate as a tool of anti-inflationary policy and for export promotion purposes. But no study to date has conducted a comprehensive evaluation of the role of external shocks and constraints for the entire period since the opening of the Mexican economy, and how the effects of external variables were either weakened or strengthened by major policy changes such as

trade liberalization and the formation of NAFTA. Surprisingly, none of the recent empirical studies has estimated or controlled for the effects of fluctuations in oil prices, which have become important again in the early 2000s. Therefore, this paper will address these concerns by estimating a model of the effects of the four major external variables that have been identified in the literature (net financial flows, real oil prices, U.S. growth, and the real exchange rate). In addition, this paper will also investigate the feedback effects of the growth rate onto the investment rate via the accelerator mechanism in an investment function and try to sort out the direction of causality (and test for simultaneity) between investment and growth.

### 3. DATA SET

The data set consists of annual data for 1979–2006.<sup>11</sup> Some of our most important variables, especially our measure of net financial inflows (which is derived from the balance of payments), are not available earlier on a consistent basis from our main data source, and market interest rates are not available from that source before the late 1970s.<sup>12</sup> Moreover, this sample period coincides with the time period since Mexico’s initial opening to the global economy via oil exports and international borrowing. However, we show earlier years for some series graphically in this section in order to put the more recent period in perspective.

The growth rate series<sup>13</sup> (solid line in figure 1) illustrates the enormous volatility of Mexico’s economy from the 1970s through the mid-1990s. After recovering from a slowdown in 1975–77, Mexico enjoyed a strong but short-lived oil boom in 1978–81. This was cut short by the sharply increased world interest rates and falling global oil prices that sparked the debt crisis of 1982–83. Another steep recession occurred in 1986 when oil prices fell further. The moderate

growth (about 4% per year) in the early post-liberalization years (late 1980s to early 1990s) ended in the peso (“tequila”) crisis of 1994–95; GDP fell by 6.2% in 1995. This was followed by a rapid recovery and brief boom in 1996–2000, a recession in 2001, and a gradual recovery thereafter. The last decade (1996–2006) exhibits less volatility than the preceding years, but the average growth rate in this period (3.7% per annum) remained disappointingly low.

[Insert Figure 1 about here]

The explanatory variables for the growth rate are:

*Net financial inflows.* To capture external financial shocks, we define this variable as the sum of the financial account balance (excluding official reserve asset transactions) plus current transfers in the balance of payments. This definition is motivated by a desire to have a measure of financial inflows that includes remittances of migrant workers along with FDI and other types of foreign investment inflows (such as bank loans and portfolio capital).<sup>14</sup> Figure 2 shows the volatility of these inflows, as well as how their composition has changed over time. “Other net financial inflows” predominated during the oil boom of 1979–81 (at which time they were primarily bank loans) and in the early 1990s (when they were primarily inflows of portfolio capital). FDI inflows increased strongly after the formation of NAFTA in 1994, but stagnated after 2001. Transfer payments (mainly worker remittances) surged in the 2000s, while other net financial inflows turned negative.<sup>15</sup> Each of the major growth crises since 1982 (shown in Figure 1) is associated with one of the sharp reversals in net financial inflows seen in Figure 2.

[Insert Figure 2 about here]

*The growth rate of U.S. real GDP.* Since the Mexican economy has become highly export dependent and about 85 percent of Mexico’s exports are sold in the U.S. market, the U.S. growth rate is likely to be an important—and exogenous<sup>16</sup>—variable for determining Mexico’s

growth rate. As can be seen in Figure 1, the correlation of the two countries' growth rates appears to have become stronger since the recovery from the peso crisis in 1996, although this is likely to be a delayed (post-crisis) reaction to the formation of NAFTA in 1994.

*The world real price of oil.* Oil prices were a major driver of cyclical swings in the Mexican economy during the 1970s and 1980s, and have acquired renewed importance since they started rising again in the 2000s.<sup>17</sup> The variable used here is the world real price of oil, which is assumed to be exogenous to the Mexican economy.<sup>18</sup> Specifically, we use the IMF's average index of three internationally quoted spot oil prices (Dubai, U.K. Brent, and Texas), deflated by the U.S. producer price index (PPI) for industrial commodities (since oil is priced in U.S. dollars). The resulting real oil price index is shown in Figure 3.

[Insert Figure 3 about here]

*The (lagged) real value of the peso.* We tried two alternative indexes for Mexico's real exchange rate. The multilateral real peso index (dashed line in Figure 4) is calculated by taking the reciprocal of the Banco de México's index of the real, consumer-price adjusted, multilateral exchange rate with 111 countries (the reciprocal is used so that a higher number indicates a real appreciation of the peso).<sup>19</sup> The bilateral real U.S. dollar-peso index (solid line in Figure 4) is calculated by taking the ratio  $CPI_{Mex}/(E \times CPI_{US})$ , where  $CPI_i$  is the consumer price index of country  $i$  and  $E$  is the nominal exchange rate in pesos/dollar.<sup>20</sup> The "maxi-devaluations" of 1976, 1982, 1986, and 1994–95 are associated with the corresponding growth declines shown in Figure 1. Since 2000, the real value of the peso has fluctuated within more narrow bounds, especially as measured by the bilateral index.

[Insert Figure 4 about here]

For the investment function, the theoretically desired dependent variable is the rate of capital accumulation, i.e., the ratio of real net investment to the (end-of-previous-period) real capital stock. However, given the difficulties in obtaining reliable measures of depreciation and the capital stock for Mexico,<sup>21</sup> we instead use the gross investment-to-GDP ratio,<sup>22</sup> where investment is measured by “gross fixed capital formation.” This gives us two alternative series, one with the numerator and denominator both measured in nominal terms and one with both measured in real terms; for the latter, the denominator (real GDP) is expressed as a Hodrik-Prescott filter of the actual series (on the presumption that a correct capital stock series would be much smoother than actual GDP).<sup>23</sup> We report the regression results using the real investment rate, but mostly similar results (available on request) are obtained with the nominal rate.<sup>24</sup>

[Insert Figure 5 about here]

To explain the investment rate, the two most standard variables to use are a measure of output growth or capacity utilization (accelerator effect) and the cost of capital funds (user cost or real interest rate) (see Chirinko, 1993; Chirinko et al., 1999). For the accelerator effect, we used the real Mexican GDP growth rate shown in Figure 1. Due to data limitations, it was not possible to construct a user cost variable for Mexico, so the real interest rate was used instead. As Figure 6 shows, nominal interest rates in Mexico (measured by the three-month treasury bill rate<sup>25</sup>) fell from high levels in the high-inflation years of the 1980s to moderate levels in the 2000s, while real interest rates (calculated using the percentage rate of change in the GDP deflator) were much lower (and frequently negative) in the 1980s and have been more stable (and more consistently positive) since the mid-1990s. The other variables used in the investment functions (real peso indexes, real oil price index, and FDI inflows) have already been shown.

[Insert Figure 6 about here]

#### 4. GROWTH EQUATIONS AND STRUCTURAL BREAK TESTS

Based on the preceding review of the literature and inspection of the data, we postulate the following equation to explain the annual growth of the Mexican economy:

$$\text{MexGrowth}_t = \beta_0 + \beta_1 \text{FinInflows}_t + \beta_2 \text{USGrowth}_t + \beta_3 \text{RealOil}_t + \beta_4 \text{RealPeso}_{t-1} + u_t \quad (1)$$

where MexGrowth is the growth rate of real Mexican GDP, FinInflows is net financial inflows as defined earlier (in percent of GDP), USGrowth is the growth rate of real U.S. GDP, RealOil is the index of the world real price of oil, RealPeso is an index of the real value of the peso (either the multilateral index, RealPesoMulti, or the bilateral index, RealPesoDollar) and  $u$  is the error term (the subscript  $t$  indicates the year). Our hypotheses are that  $\beta_1, \beta_2, \beta_3 > 0$  and  $\beta_4 < 0$ .

We use a one-year lag of the real peso index for two reasons. First, the current-year real exchange rate can be affected by Mexico's growth (for example, because strong growth generally attracts capital inflows and may also spark higher inflation). In contrast, the previous year's exchange rate can be considered pre-determined or exogenous since it cannot have been influenced by the current year's growth. Second, the exchange rate affects growth primarily through its effects on international trade, and trade effects typically occur with so-called "J-curve" lags due to the time it takes to order, produce, and ship goods across national borders in response to exchange rate changes.

Before estimating equation (1), we have to test for the time-series properties of the variables. Using a 10% significance threshold, Phillips-Peron tests show that the null hypothesis of a unit root can be rejected for MexGrowth, USGrowth, FinInflows, and RealPesoDollar, but the null must be accepted for RealOil and RealPesoMulti.<sup>26</sup> Using the alternative test due to



Kwiatkowski et al. (1992), for which the null hypothesis is that the series is stationary, we can accept the null for all of the variables at any significance level between 1% and 10%, except the results for USGrowth are sensitive to the bandwidth selection method (the null can be accepted at all conventional significance levels using the Andrews method, but only at 1% using Newey-West). Since most of the data series do not have unit roots according to most tests, it would be inappropriate to test for cointegration or use cointegration procedures.

Nevertheless, there is enough evidence of possible unit roots for some of the variables that equation (1) should be estimated using a method that is robust to the inclusion of series that may have unit roots. Such a method exists in the dynamic ordinary least squares (DOLS) approach of Stock and Watson (1993), in which each right-hand-side (RHS) variable is entered both in level and first-difference form; the coefficients on the first differences control for dynamic adjustments to the long-run equilibrium while the coefficients on the levels are estimates of the long-run effects.<sup>27</sup> Thus, the equation we actually estimate is:

$$\begin{aligned} \text{MexGrowth}_t = & \beta_0 + \beta_1 \text{FinInflows}_t + \beta_2 \Delta \text{FinInflows}_t + \beta_3 \text{USGrowth}_t + \beta_4 \Delta \text{USGrowth}_t \\ & + \beta_5 \text{RealOil}_t + \beta_6 \Delta \text{RealOil}_t + \beta_7 \text{RealPeso}_{t-1} + \beta_8 \Delta \text{RealPeso}_{t-1} + v_t \end{aligned} \quad (2)$$

where  $\Delta$  is the difference operator and  $v$  is the error term. Our hypotheses can now be restated as  $\beta_1, \beta_3, \beta_5 > 0$  and  $\beta_7 < 0$  (we are not concerned with the signs of the differenced terms).

The results of estimating equation (2) are shown in Table 1. We begin with equation (1.1), which omits either RealPeso index. All the other variables are significant in levels and have the expected signs. FinInflows has a coefficient of 0.64 and is significant at the 1% level; RealOil has a coefficient of 0.025 and is significant at the 10% level; and USGrowth has a coefficient of 0.82 and is significant at the 5% level. The Durbin-Watson statistic and other diagnostic tests do not reveal any significant problems (except the Chow breakpoint tests, which

will be discussed later). When RealPesoMulti is included in equation (1.2), all the variables have their expected signs and appear to be significant (in levels), but the Durbin-Watson statistic is high at 2.461, and the RESET tests indicate significant misspecification error (at the 5% level using squared fitted values and the 1% level using cubed fitted values). When RealPesoDollar is used instead in equation (1.3), the equation passes all of the diagnostic tests for random residuals (there is no significant autocorrelation of the residuals according to either Durbin-Watson or Breusch-Godfrey, and we cannot reject the null hypothesis that the residuals are normally distributed according to Jarque-Bera), and there is no significant misspecification bias (according to RESET). However, the USGrowth variable becomes insignificant in equation (1.3).

[Insert Table 1 about here]

Based on the data in Figure 1 as well as our literature review, we suspect that the effects of U.S. growth on Mexico may have become more pronounced (and statistically significant) after the two countries joined NAFTA in 1994. Moreover, given the major policy shifts in Mexico since the 1980s, the effects of other variables on growth may also have changed during our sample period. As Table 1 shows, Chow breakpoint tests indicate significant structural breaks in 1994 in equations (1.1) and (1.3) at the 5% level using the *F*-statistic and equations (1.1) through (1.3) at the 0.1% level using the likelihood ratio (LR) test.<sup>28</sup> Therefore, we proceed to conduct a series of tests for structural change in the growth equation, using equation (1.3)—which has the best statistical properties of the first three equations in Table 1—as a baseline model.

The results of several structural break tests are reported in Table 2. We used two alternative dummies: DLiberal, which is 1 during the liberalization period (defined as 1988–2006) and 0 otherwise;<sup>29</sup> and DNAFTA, which is 1 in 1994–2006 and 0 otherwise. These dummies were employed in an interactive fashion by multiplying them times each of the

variables in the growth model.<sup>30</sup> Although we used DOLS estimation, the coefficients on the differenced variables are not reported here for reasons of space (complete results are available on request). Thus, the coefficients shown in Table 2 are the coefficients on the levels of the variables, which in a DOLS specification capture long-run effects.

[Insert Table 2 about here]

In equation (2.1), the interactive variable DNAFTA\*USGrowth is positive and significant at the 5% level ( $p$ -value of 0.013), while the plain USGrowth variable is insignificant, thus indicating that U.S. growth had a significant effect only after NAFTA was adopted.<sup>31</sup> Since estimates with insignificant variables included are inefficient, we re-ran the equation omitting USGrowth (without the dummy) and including only the interactive term DNAFTA\*USGrowth. The long-run coefficients are reported in column (2.2) of Table 2 and—since this ends up being our preferred specification for reasons indicated below—complete results (including differenced variables) are also given in column (1.4) of Table 1. In this equation, all variables are significant and have their expected signs in levels. FinInflows, RealOil, and RealPesoDollar are significant at the 1% level, while DNAFTA\*USGrowth is significant at the 5% level. The coefficient on the latter variable implies that a 1 percentage point change in the U.S. growth rate causes the Mexican growth rate to change by 0.53 percentage points in the same direction, but only after NAFTA went into effect. This equation also finds a strongly positive effect of FinInflows (0.68) and a negative effect of lagged RealPesoDollar (−0.16). The included variables explain 86% of the variation in the Mexican growth rate during the sample period, while the diagnostic tests indicate no problems with the residuals or specification.

Then, using equation (2.2) as a new baseline model, we proceed to test for structural breaks in the effects of the other independent variables.<sup>32</sup> In equation (2.3), the significant

negative coefficient on  $D\text{Liberal} * \text{FinInflows}$  indicates that there was a significant reduction in the effect of net financial inflows after 1988 (a similar test using DNAFTA, not shown in the table, does not find a significant change in the effect of this variable after 1994). In equation (2.4), the significant negative coefficient on  $D\text{Liberal} * \text{RealOil}$  indicates that there was a significant lessening of the impact of oil prices after 1988 when, in addition to liberalizing its trade, Mexico had begun to export more manufactures than oil (a similar test using DNAFTA, not shown in the table, also finds a significant change in the oil price effect after 1994). Both of these variables ( $\text{FinInflows}$  and  $\text{RealOil}$ ) continue to have significant, albeit reduced, effects after 1988.<sup>33</sup> However, both equations (2.3) and (2.4) show evidence of serial correlation of the residuals in the high Durbin-Watson statistics and some of the Breush-Godfrey LM tests (see notes a and b to Table 2), leading to uncertainty about the validity of the hypothesis tests for these equations.

Finally, columns (2.5) and (2.6) of Table 2 report tests for whether either the trade liberalization of the late 1980s or the formation of NAFTA in 1994 increased the sensitivity of the Mexican growth rate to the real exchange rate. Although the estimated coefficients on the interactive dummy terms have negative signs in both of these equations, indicating stronger negative effects, both coefficients are statistically insignificant at the 10% level. Thus, our findings for structural breaks in the growth equation can be summarized as follows: U.S. growth became significant only after NAFTA went into effect in 1994; both net financial inflows and oil prices began to have smaller (but still statistically significant) effects after Mexico's liberalizing reforms of the late 1980s; and there were no statistically significant changes in the effects of the real exchange rate.

## 5. INVESTMENT FUNCTIONS

Turning to the investment function, a convenient baseline specification that is relevant for the structural conditions of Mexico is the following (ignoring lags for simplicity at this point):

$$\begin{aligned} \text{InvRate}_t = & \alpha_0 + \alpha_1 \text{MexGrowth}_t + \alpha_2 \Delta \text{RealInterest}_t + \alpha_3 \text{RealPeso}_t + \alpha_4 \text{RealOil}_t \\ & + \alpha_5 \text{FDI-GDP Ratio}_t + \varepsilon_t \end{aligned} \quad (3)$$

where  $\text{InvRate}$  is the real investment rate (real gross capital formation as a percentage of Hodrik-Prescott-filtered real GDP),  $\text{MexGrowth}$  represents the accelerator effect,  $\Delta \text{RealInterest}$  is the change in the cost of capital funds (as noted earlier, the data required to construct the theoretically preferred user cost of capital are not available),  $\text{FDI-GDP Ratio}$  is FDI inflows as a percentage of GDP (the darkest shaded area in Figure 2),  $\varepsilon$  is the error term, and the other variables are defined as before. The interest rate variable is entered in differenced form because it affects the desired stock of capital, and investment is the *change* in the capital stock (see Chirinko et al., 1999; Campa and Goldberg, 1999). The expected signs on  $\text{MexGrowth}$  and  $\Delta \text{RealInterest}$  are  $\alpha_1 > 0$  and  $\alpha_2 < 0$ .

A real exchange rate index is included because, in an open economy, relative prices of foreign and domestic goods can be important determinants of the national location of investment (see Campa and Goldberg, 1999; Blecker, 2007). In general terms, a higher value of the home currency makes the home country a less competitive location for the production of traded goods, because it makes local inputs relatively more expensive, but it also cheapens imports of capital and intermediate goods that are used in local production and therefore can stimulate investment in activities that are intensive in those imported inputs. Hence, the net effect of the real exchange

rate on total investment (the sign of  $\alpha_3$ ) is ambiguous *a priori* (and is likely to differ between industries with different structural characteristics). We also include the real oil price index because, historically, investment in Mexico has been highly correlated with oil prices due to the leading role of the oil industry in government finances and hence in financing public investment (which is included in the data for “gross fixed capital formation” used here to represent total investment).<sup>34</sup> We also include FDI inflows (normalized by GDP) to test whether (or to what extent) FDI has positively contributed to total investment.<sup>35</sup>

With regard to stationarity, *InvRate* has a unit root according to a Phillips-Peron test at a 10% significance threshold, although the  $p$ -value is only 0.126. In contrast, the Kwiatkowski test shows that *InvRate* is stationary at all conventional significance levels (the LM statistic is 0.132, with a 10% critical value of 0.347). *MexGrowth* and  $\Delta$ *RealInterest* are stationary according to both tests at all conventional significance levels. The two real peso indexes are both stationary according to Kwiatkowski tests at all significance levels, but according to Phillips-Peron only *RealPesoDollar* is stationary at the 10% level ( $p$ -value of 0.098; *RealPesoMulti* has a  $p$ -value of 0.123). *RealOil*, as noted earlier, has a unit root according to Phillips-Peron but is stationary according to Kwiatkowski. The FDI-GDP ratio has a unit root according to Phillips-Peron, and using Kwiatkowski it is stationary at the 1% level but not at 5% or 10% with an intercept only (with a trend also included, it is significant at 1% and 5% but not 10%).

Although these tests suggest that unit roots are not likely to be a major concern in the investment function (3)—especially in estimates that omit the FDI-GDP ratio—we are unable to reject unit roots unambiguously for some of the variables. Therefore, we begin by estimating (3) using DOLS, which (as noted earlier) yields robust estimates of long-run relationships in the presence of possibly nonstationary variables. This means that we must include the differences of

all the RHS variables in the estimated equation. The best estimates were obtained using 0 to 2 lags of  $\Delta\text{MexGrowth}$  and 0 to 1 lags of  $\Delta(\text{DLiberal}*\Delta\text{RealInterest})$  and  $\Delta\text{RealOil}$ ; for the other variables only the contemporaneous difference (0 lag) was used. For the real exchange rate, we use  $\text{RealPesoDollar}$  rather than  $\text{RealPesoMulti}$ , since the former shows less evidence of a unit root, and also because using the latter results in more evidence of serially correlated residuals and specification bias (although the estimated coefficients using  $\text{RealPesoMulti}$  are qualitatively similar to those found using  $\text{RealPesoDollar}$ ).

Three alternative DOLS estimates of equation (3) are shown in columns (3.1) to (3.3) of Table 3. Only the long-run coefficients (coefficients on the levels of the variables) are shown in this table for reasons of space (complete results including the differenced variables are available on request). In equation (3.1), which omits the FDI-GDP ratio and includes the differenced real interest rate for all years (i.e., with no interactive dummy),  $\Delta\text{RealInterest}$  is negative but not significant at the 10% level. This equation also has other problems, including first-order serial correlation of the residuals (according to the Durbin-Watson statistic and the Breusch-Godfrey tests for one and three lags) and likely equation misspecification according to the RESET test with cubic fitted values (significant at 0.1%).

We surmise that the insignificant effect of the real interest rate and other problems may be due to the inclusion of data from before the period of financial liberalization, when investment finance was largely government controlled.<sup>36</sup> Therefore, in column (3.2), we estimate an analogous equation in which the interest rate is interacted with the liberalization dummy variable,  $\text{DLiberal}$ , defined earlier. The interactive variable  $\text{DLiberal}*\Delta\text{RealInterest}$  is negative and significant at the 0.1% level, implying that real interest rates began to affect investment only after Mexico began to liberalize its economy. In equation (3.2), the accelerator effect

(MexGrowth) is strong and significant (coefficient of 0.68), RealPesoDollar is also positive and significant (signifying that the benefits of cheaper imports of capital and intermediate goods outweigh the disadvantages of higher domestic costs), and RealOil is also positive and significant (all at the 0.1% level). However, this equation is still marred by serially correlated residuals (with one lag) and likely misspecification bias.

[Insert Table 3 about here]

FDI inflows are incorporated in equation (3.3) in Table 3, which preserves the interactive liberalization dummy on  $\Delta\text{RealInterest}$ . While the other coefficients have similar estimated coefficients and standard errors (and  $p$ -values) to those found in equation (3.2), the FDI-GDP ratio is positive and significant at the 10% level. The coefficient is only about 0.2, however, indicating that FDI inflows have a relatively small impact on total investment. Including FDI inflows eliminates the serial correlation of the residuals, but not the misspecification bias that is still found according to the cubic RESET test. Since the  $p$ -value for the FDI-GDP ratio is barely below 10% (0.098), we must be cautious in assessing whether this is truly a significant effect.

Since all of the DOLS estimates show strong evidence of misspecification bias in the cubic RESET tests, and since there was only weak evidence of nonstationarity problems in the investment function to begin with, we re-estimate it using a simpler distributed-lag specification with the following lag structure:<sup>37</sup>

$$\begin{aligned} \text{InvRate}_t = & \alpha_0 + \sum_{i=0}^2 \alpha_{1i} \text{MexGrowth}_{t-i} + \sum_{j=0}^1 \alpha_{2j} \text{DLiberal}_{t-j} * \Delta\text{RealInterest}_{t-j} + \alpha_3 \text{RealPeso}_t \\ & + \alpha_4 \text{RealOil}_t + \alpha_5 \text{FDI-GDP Ratio}_t + v_t \end{aligned} \quad (4)$$

Results of estimating three different versions of (4) are shown in columns (3.4) to (3.6) in Table 3 (the coefficients shown for MexGrowth and DLiberal\* $\Delta\text{RealInterest}$  are the sums of the



coefficients  $\alpha_{1i}$  and  $\alpha_{2j}$ , respectively, which represent the long-run effects; additional lags of these variables were not significant). The results are qualitatively similar to those found in the parallel equations (3.1) to (3.3), but the estimated coefficients (other than the constant) in equations (3.4) to (3.6) are mostly somewhat smaller in absolute value than the analogous estimated coefficients in (3.1) to (3.3)—especially for the interest rate effects (which are significant only at the 10% level in equation 3.5 and at the 5% level in 3.6). The estimated effect of the FDI-GDP ratio is only slightly higher in equation (3.6) compared with (3.3) (0.25 versus 0.22), and again is significant only at the 10% level ( $p$ -value of 0.083). In equation (3.6), however, we once again find serially correlated residuals according to the Breusch-Godfrey test with two lags. At best, FDI inflows appear to have only a small and uncertain impact on the overall investment rate in Mexico, after controlling for the other determinants of domestic investment.

In all of the last three columns in Table 3, there is only weaker evidence for equation misspecification (the cubic RESET statistics are significant at the 10% level, but not at 5%), and in two of these equations (3.4 and 3.5) we find no evidence of serially correlated residuals. Consequently, although we were unable to find a perfect specification of the investment function, we have greater confidence in the accuracy of the hypothesis tests for the distributed lag equations compared with the DOLS estimates, and the fact that two different specifications yield qualitatively similar results gives us greater overall confidence in our estimates.<sup>38</sup>

## 6. SIMULTANEOUS EQUATIONS ESTIMATES

Either equation (3) or (4) when combined with equation (2) (or any permutation thereof

involving interactive dummy terms) constitutes a special type of simultaneous equations system known as a “triangular” or “recursive” system, since in the former equations the investment rate is a function of an endogenous variable (the growth rate), but the growth rate is assumed not to depend on the investment rate in the growth equations. Whether this is a valid specification is discussed further below; first we consider whether the ordinary least squares (OLS) estimates of these equations in the previous two sections yield reliable (i.e., unbiased and consistent) results.<sup>39</sup> OLS estimates of a recursive system of equations are consistent and unbiased, provided that the residuals from the equations are not correlated (see Greene, 1997, pp. 715–16, 732, 736–37). To test whether the preceding estimates are consistent and unbiased, therefore, we used Breusch & Pagan (1980) Lagrange multiplier (LM) tests<sup>40</sup> for correlation of the OLS residuals for various pairs of growth and investment equations from Tables 1 and 3, respectively. These tests (results of which are available on request) show that none of the residuals from any pairs of growth and investment equations are significantly correlated at the 10% level.<sup>41</sup> This indicates that the OLS estimates of these equations do not exhibit significant cross-equation correlation of the residuals, and hence are unbiased and consistent.

The second set of simultaneity issues has to do with whether the recursive model is a correct specification of the short-run relationship between growth and investment. It might be thought that the investment rate, considered as an important indicator of domestic demand shocks, should be included in the growth rate equations. This would essentially add a Keynesian “multiplier” effect in the (output) growth equation to the accelerator effect found in the investment function. To address this question, we first used Hausman weak exogeneity tests.<sup>42</sup> These tests showed that MexGrowth is weakly exogenous in the InvRate equation (the residuals from the first-stage regression for MexGrowth are insignificant in the second-stage regression for

InvRate), while InvRate is not weakly exogenous in the MexGrowth equation (the residuals from the first stage regression for InvRate are significant at the 1% level in the second-stage regression for MexGrowth).<sup>43</sup> These results suggest that InvRate is a function of MexGrowth but MexGrowth is not a function of InvRate.

As a further test for the direction of causality between growth and investment, we consider a specification of the growth model in section 4 in which InvRate is included in the equation for MexGrowth. Combined with one of the investment functions from section 5, this gives us a truly simultaneous system, which we can use to test for whether InvRate is significant in the MexGrowth equation (in which case, the correct model would be simultaneous and not recursive—and the growth equations without InvRate would also suffer from omitted variable bias). In the presence of true simultaneity, OLS estimates are biased even if the residuals are uncorrelated. Therefore, we estimated various pairs of growth and investment equations, with the former modified to include InvRate, using two-stage least squares (2SLS). In all cases, the 2SLS residuals were not significantly correlated according to Breusch-Pagan tests.<sup>44</sup> Therefore, the 2SLS results are unbiased and consistent, and it is not necessary to use three-stage least squares.

Results of two typical pairs of 2SLS regressions are shown in Table 4. These estimates combine our preferred specification of the growth equation (column 1.4 in Table 1, which is the same as column 2.2 in Table 2),<sup>45</sup> with InvRate added in as a regressor, along with two alternative investment functions, one excluding and one including the FDI-GDP ratio (essentially, equations analogous to columns 3.5 and 3.6 from Table 3). Both pairs of equations (columns 4.1a-b and 4.2a-b) satisfy the rank and order conditions for identification of the parameters. All the exogenous and lagged variables in both pairs of equations were used as instruments for each set of estimates. Due to the small sample size, we were unable to obtain

precise estimates using the DOLS approach, i.e., with the differenced RHS variables included.<sup>46</sup>

Therefore, we included only the levels of the RHS variables (sensitivity tests showed that this did not substantially change the estimated coefficients on the variables in levels, but notably reduced the standard errors of those estimated coefficients). Similarly, we used the distributed lag version of the investment function rather than the DOLS specification, especially since the latter also had problems of serially correlated residuals and misspecification bias.

[Insert Table 4 about here]

In equations (4.1a) and (4.1b) in Table 4, the estimated coefficients on the other variables are not much changed, compared to equations (1.4) and (3.5) in Tables 1 and 3 respectively, as a result of the inclusion of InvRate in the MexGrowth equation (as well as the use of 2SLS and the omission of the differenced variables)—although the real interest rate becomes insignificant in the investment equation (4.1b). The coefficient on InvRate, while positive, is not significant at the 10% level ( $p$ -value of 0.188). These results indicate that growth equation (1.4) did not suffer from significant simultaneity or omitted variable bias, and that the recursive model consisting of that equation along with (3.5) for investment is superior to the simultaneous model (4.1a-b).

One qualification is that, in the simultaneous estimates of equation (4.1a), the coefficient on RealOil—in addition to dropping about half in value relative to equation (1.4)—is statistically insignificant ( $p$ -value of 0.248). We suspect that this results from the high correlation of the real oil price with the investment rate: the simple correlation coefficient between these two variables is 0.56, and RealOil is positive and significant in all the estimated InvRate equations. Given the close correlation of these two variables, it may be impossible to definitively tease out their respective effects on growth, and hence our conclusion of no simultaneity must be interpreted with caution. However, since the world real oil price index is exogenous to the Mexican

economy, the strong correlation of that index with the investment rate suggests that investment is driven by oil prices and not the other way around, and hence the exogenous variable whose shocks really drive growth is the oil price and not the investment rate.

Equations (4.2a) and (4.2b) in Table 4 repeat the same exercise, but including the FDI-GDP ratio as a regressor in the investment equation. In these estimates, the FDI-GDP ratio was treated as an endogenous variable, with its lagged value included in the instrument list for the 2SLS procedure (but qualitatively similar results were obtained when this ratio was treated as exogenous). The results show that the FDI-GDP ratio retains its positive coefficient, which is now about double the previous estimates from Table 2 (roughly, 0.4 versus 0.2), but this ratio is insignificant in the 2SLS estimates ( $p$ -value of 0.119). This suggests further caution in assessing the impact of FDI inflows on total investment. In this last set of estimates, *InvRate* is significant in the *MexGrowth* equation (4.2a) at the 10% level ( $p$ -value of 0.073). Although this might suggest that the simultaneous equations model is valid, this result is found only in a two-equation model that includes an insignificant variable (the FDI-GDP ratio) in the equation for the endogenous variable *InvRate*; furthermore, there is still multicollinearity between this variable and *RealOil*, and *InvRate* is not significant in the growth equation at the 5% level.

Thus, the preponderance of evidence suggests that investment in Mexico is a function of growth but not vice-versa, i.e., the relationship is one-way and not simultaneous, in the short run. Put another way, there is strong evidence for an accelerator effect of growth on investment, but no robust evidence for a multiplier effect of investment on growth. While this finding may seem surprising, it suggests the persistent strength of external constraints on economic growth in Mexico during our sample period. External shocks, rather than domestic events, appear to have driven the fluctuations in Mexico's growth since the early 1980s, and even "internal" variables

such as investment seem to be heavily influenced by some of those same external variables (including the indirect effects on investment of the external shocks that affect the growth rate). Of course, these results do not preclude the possibility that the low average investment rate may have contributed to the slow average growth in the post-1980 period, but tests for that hypothesis would require a different methodology.

## 7. SIMULATED EFFECTS

Assuming that the recursive DOLS/OLS estimates are the correct ones, it is a simple matter to simulate the quantitative impact of shocks to the main exogenous variables on domestic growth and investment. In the top part of Table 5, we simulate the “long-run” (i.e., equilibrium) effects of a one standard deviation increase in each exogenous variable on each of the two endogenous variables. For this purpose, we use equation (1.4) from Table 1 for growth and (3.6) from Table 3 for investment (in order to be able to estimate FDI effects). The variables whose standard deviations have the largest impact on the growth rate are net financial inflows (+2.3 percentage points) and the real dollar-peso index (−2.3 percentage points). Next in quantitative importance is the real oil price index (+1.8 percentage points), followed by the U.S. growth rate (+0.6 percentage points).

[Insert Table 5 about here]

For the investment rate, the largest impact factor (including both direct effects and indirect effects via the growth rate) is the oil price index, followed by net financial inflows (which have only an indirect effect through growth); these effects are +2.0 and +1.4 percentage points, respectively. One standard deviation changes in the other exogenous variables have only

small net effects on the investment rate. Notably, for the real dollar-peso index, the negative indirect effect via the growth equation is greater than the positive direct effect in the investment equation, resulting in a negative net impact of real peso appreciation on the investment rate (although this negative net effect is relatively small).

To assess the importance of external shocks during the most recent decade, the bottom part of Table 5 shows the simulated long-run (equilibrium) effects of the changes in the exogenous variables between the recovery period of 1996–2000 and the slower growth period of 2001–6. For this simulation, while we continue to use equation (3.6) for investment, we utilize equation (2.4) for growth in order not to exaggerate the importance of oil prices in the more recent period.<sup>47</sup> These results are estimates of the equilibrium effects assuming that the changes in the averages for the exogenous variables between the two periods are permanent; hence, these estimates should not be interpreted literally as predictions of the actual changes between these two time periods, because those changes were influenced by lags and short-run dynamics.

According to these simulations, the increased real value of the peso has the largest negative impact on the Mexican growth rate between 1996–2000 and 2001–6 (–1.3 percentage points), while the reduction in the U.S. growth rate reduces Mexican growth by –1.2 percentage points and lower net financial inflows cut the growth rate by –0.6 percentage points. The increased world oil price between these two periods is estimated to have imparted a boost of +1.3 percentage points to the growth rate, thus offsetting only part of the negative effects (although a higher estimate is obtained if we use a growth equation without a structural break on the oil price effect). These simulations also show that the increase in world oil prices between 1996–2000 and 2001–6 had a strongly positive long-run effect on the investment rate (+1.8 percentage points, including both direct and indirect effects), while reduced net financial inflows and slower U.S.

growth had smaller negative effects ( $-0.4$  and  $-0.8$  percentage points, respectively). Changes in the other variables (the real dollar-peso index, real interest rate, and FDI-GDP ratio) had negligibly small net effects on investment between those periods.

## 8. CONCLUSIONS

This article has found evidence that most of the variation in Mexico's growth rate since 1979 can be explained, parsimoniously, by shocks to four external factors: net financial inflows, world oil prices, U.S. growth, and the lagged real exchange rate. The first three are clearly exogenous with respect to the Mexican growth rate (as verified by Hausman weak exogeneity tests, available on request), while the last one can be considered exogenous because it is lagged in the regression model (and the real exchange rate is "external" in the sense that it reflects Mexico's price competitiveness in foreign trade). Tests for structural breaks show (subject to some uncertainty about the hypothesis tests due to residual autocorrelation) that the post-1988 economic liberalization policies reduced, but did not eliminate, the constraining effects of net financial inflows and oil prices on Mexican growth, while the formation of NAFTA in 1994 created a significant dependency of Mexico's growth on U.S. growth that did not exist previously. We found that there was no statistically significant change in the effect of the real exchange rate either post-liberalization or post-NAFTA, although the coefficient estimates are consistent with the view that the negative effects of peso appreciation may have become slightly more pronounced.

Real oil prices, the FDI-GDP ratio, and changes in real interest rates have the expected effects on the investment rate (positive, positive, and negative, respectively), but all of these



effects vary in statistical significance depending on the specification of the investment function. The real value of the peso has a positive direct effect on investment, but this effect is roughly cancelled out (in some estimates, more than cancelled out) by the negative indirect effect via the growth rate. We also found that the real investment rate in Mexico is subject to a strong and significant accelerator (growth) effect, but according to most of our tests there is no statistically significant reciprocal effect of the investment rate on the growth rate in the short run. In other words, the causality in the Mexican macroeconomy appears to go from external shocks to growth to investment, with no significant feedback (multiplier effect) of investment on short-run growth. This suggests an economy that, after two decades of market-oriented reform efforts, remains heavily dependent on external forces as the motor of its expansion and highly vulnerable to adverse external shocks (e.g., a future U.S. recession or possible fall in oil prices).

Of course, these results need to be heavily qualified to the extent that they explain only the variations in Mexico's short-run growth since the early 1980s, and not the long-run decrease in the average growth rate during this period compared with earlier decades. However, the results in this paper do suggest a new direction for future research on the causes of the long-term growth slowdown. Previous research (cited earlier) suggests that Mexico's economic opening of the 1980s and beyond made it more constrained by its balance of payments and other external conditions than it was in the preceding decades, and this paper verifies the strength of those external factors during the post-1980 period. Further research is needed, however, to determine if the increased exposure to external constraints since 1980 has been one of the causes of the longer-term growth slowdown.

The results in this paper also have important implications for policy efforts aimed at boosting the growth of the Mexican economy. Obviously, Mexico is too small to influence truly

exogenous variables such as U.S. growth or world oil prices. Mexico could, however, seek to renegotiate NAFTA or alter its other trade and industrial policies in ways that would promote industries with higher domestic content (i.e., greater backward linkages). Mexico has important decisions to make about the future of its energy sector in light of dwindling exploited reserves and the potential for future volatility in energy prices. Mexico could try to modify its monetary and exchange rate policies so as to target a lower real value of the peso, if this could be done without reigniting high inflation or sparking another financial crisis. Mexico also can pursue financial policies that avoid destabilizing fluctuations in net financial inflows. In fact, those inflows have been less volatile since the late 1990s, but they have also trended downward since that time. Perhaps most importantly, Mexico needs to reconsider what kinds of structural reforms and policy approaches would best enable the country to relax its external constraints and become less vulnerable to external shocks.

Finally, although our results suggest that growth drives investment and not vice-versa in the short run, nothing in this paper denies that a low rate of capital accumulation could be a significant factor in the slow long-run (average) growth of the Mexican economy since 1980. However, if that is the case, our results imply that policies that could stimulate growth in the short run would also have a long-run payoff, insofar as encouraging more investment in the short run leads to a larger capital stock embodying new generations of technology in the long run. In other words, Mexico may not be able to achieve a better long-run growth trajectory unless it finds a way to stimulate the economy more independently of external constraints in the short run.

## NOTES

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<sup>1</sup> Based on data from International Monetary Fund (2007a); inflation data are for changes in consumer prices.

<sup>2</sup> If we ignore the worst years of the debt crisis and focus on the period since Mexico began to liberalize its foreign trade, its growth rate averaged 3.1% per year in 1987–2006. Data for 1951–80 are from Urquidí (2003, p. 562, Table 15.1); the later data are from our own data set described in section 3, below.

<sup>3</sup> See section 2 below for citations to relevant studies.

<sup>4</sup> See, for example, Ros (1995) and Blecker (1996).

<sup>5</sup> Data on maquiladora exports and imports were obtained from Instituto Nacional de Estadística, Geografía e Informática (INEGI, [www.inegi.gob.mx](http://www.inegi.gob.mx)).

<sup>6</sup> Ibarra (2006) finds that a dummy variable for NAFTA's entry into effect in 1994–95 has a positive effect on the growth rate of manufactured exports, but the coefficient is significant only at the 10% level and he does not estimate a parallel equation for imports.

<sup>7</sup> Ibarra uses data for the gross operating surplus of producers in Mexico's national income accounts that are only available beginning in 1988. Ortiz C. (2005) constructs indexes of profitability in the Mexican economy for longer periods (up to 1950–2002) by using the differences between the growth rates of labor productivity and real wages.

<sup>8</sup> Also, Ibarra measures investment as the percentage rate of growth of real fixed investment, while it is more common to measure investment as a ratio to the capital stock (or, if reliable capital stock estimates are not available, as a ratio to GDP), and his investment function does not control for the cost of capital funds (real interest rate).

<sup>9</sup> See, e.g., Faal (2005), cited in Moreno-Brid & Ros (2009).

<sup>10</sup> Moreno-Brid & Ros (2009); cited with permission of the authors and Oxford University Press from page 204 of the manuscript dated July 2007. A related argument holds that Mexico has failed to invest enough in human capital. However, Moreno Brid & Ros (2009) point out that educational attainment indicators for Mexico have risen substantially since 1980, and that there seems to be underutilization of educated labor. They also argue that, to the extent that educational expenditures have been inadequate, this has been an effect of the macroeconomic crises and the fiscal stabilization policies used to address them, rather than an exogenous cause of slower growth.

<sup>11</sup> Given our interest in what might be termed the “medium-run” performance of the Mexican economy, i.e., over periods of a few years (including lagged effects), rather than very short-run fluctuations, quarterly data would be likely to add more noise than information, in spite of their potential to increase the number of observations. Also, the Mexican quarterly data that are available for most series are generally not seasonally adjusted.

<sup>12</sup> Most data series in this paper were taken from the International Monetary Fund, *International Financial Statistics Online*, hereafter referred to as “IFS,” except as otherwise noted. The IFS data for Mexico's balance of payments start in 1979. The Banco de México website ([www.banxico.gob.mx](http://www.banxico.gob.mx)) contains older data for the balance of payments, but the pre-1980 data are not completely consistent with the later data, and the IFS evidently does not consider the earlier data to be of equivalent quality.

<sup>13</sup> The growth rates (annual percentage changes) were calculated from the “volume index” for real GDP in the IFS. This index splices together constant-peso series derived from different base years.

<sup>14</sup> Traditionally, net resource transfers are defined as the balance of trade for goods and services with the sign reversed; this concept was used in some of the studies of Mexico's external financial flows discussed earlier. Hausman tests (available on request) verify that both net resource transfers and net financial inflows (measured as percentages of GDP) are weakly exogenous in the growth model, and the coefficient estimates from the growth regressions are very similar (both qualitatively and quantitatively) using the two variables, so none of the substantive results in the paper depend on this difference in definition. However, (again measured as percentages of GDP) net resource transfers have a unit root according to a Phillips-Peron test, while net financial inflows as defined here are stationary according to the same test. Also, using net resource transfers in the growth equations leads to misspecification bias according to Ramsey RESET tests (all of these estimates and tests are available on request). Thus, the definition used here is preferred on statistical grounds. The International Monetary Fund (IMF, 2007b, Statistical Appendix, Table B18)—which offers its own (different) measure of “net external financing”—states that, “It should be noted that there is no generally accepted standard definition of external financing” (p. 28n5).

<sup>15</sup> IFS data on total unilateral current transfers received go back to 1979, while Mexican government data on “remesas familiares” (family remittances) go back only to 1995. However, based on the data for the overlapping years (1995–2006), it is clear that the vast majority of transfers (well over 90%) are remittances.

<sup>16</sup> U.S. bilateral trade with Mexico is so small in relation to U.S. GDP that Mexico's growth is unlikely to have an appreciable impact on U.S. growth. As of 2004, U.S. exports of goods and services to Mexico represented 1.1% of U.S. GDP, while U.S. imports of goods and services from Mexico accounted for 1.5% of U.S. GDP (calculated from data obtained from U.S. Department of Commerce, Bureau of Economic Analysis, [www.bea.gov](http://www.bea.gov)).

<sup>17</sup> The value of Mexico's oil exports more than doubled from US\$18.6 billion in 2003 to US\$39.0 billion in 2006. Source: INEGI, Banco de Información Económica, Sector externo, Exportaciones petroleras y no petroleras, <http://dgcnesp.inegi.gob.mx/cgi-win/bdieinti.exe/NIVJ100005>, and author's calculations.

<sup>18</sup> Actual oil revenue may be partly endogenous to the growth process insofar as the government-run energy monopoly (PEMEX) adjusts its export strategy in response to economic conditions. See Puyana (2006) on Mexican oil policy and how it has responded to various economic and fiscal incentives.

<sup>19</sup> We used the series, “Índice de tipo de cambio real (ITCR), con precios consumidor y con respecto a 111 países,” based at 100 in 1990 (from Banco de México, [www.banxico.gob.mx](http://www.banxico.gob.mx)). In addition to taking the reciprocal, we calculated annual averages of the monthly data and converted to a 2000 base year.

<sup>20</sup> The bilateral peso-dollar real exchange rate index was constructed using consumer price indexes for comparability with the multilateral real exchange rate index from the Banco de México. Although in principle a producer price index (PPI)-based real exchange rate might be a better measure of the relative price of tradable goods, the Mexican PPI for non-oil commodities shows an anomalous large drop-off in 1981, which results in a parallel anomalous movement in the real exchange rate.

<sup>21</sup> The Mexican government has not published an official capital stock series in several years. Loría and de Jesus (2007) cite a Banco de México series that was discontinued after 2003, as well as previously published critiques of the methodology used for that series. Loría and de Jesus (2007) provide their own estimates of quarterly capital stocks from 1980:1 to 2004:4 based on the perpetual inventory method. However, these estimates have several problems: (1) they show an implausibly large decline in the capital stock during the debt crisis of the 1980s that is not fully reversed until after 2000; (2) the estimated capital stock appears too highly correlated with the current flow of investment; and (3) the estimates imply a large increase in capital productivity (the output-capital ratio) between 1980 and 2000 that is not found in any other research. These problems seem to derive from an excessively large adjustment to the capital stock series for the initial periods.

<sup>22</sup> Note that using the investment-GDP ratio essentially assumes a constant capital-output ratio or unchanged capital productivity—an assumption that is neutral but untestable, given the lack of capital stock data described in the preceding note.

<sup>23</sup> The Hodrik-Prescott filter was applied using a power value of 4, as suggested by Ravn and Uhlig (2002). This results in a trend that better approximates the medium-run cycles in Mexican output, as compared with a power value of 2 (as originally suggested by Hodrik and Prescott, 1997) which results in a smoother, more long-run trend.

<sup>24</sup> The main differences in the results using the nominal investment rate are that the real peso indexes are never significant and there is significant serial correlation of the residuals. Also, the FDI variable is insignificant in some specifications with the nominal investment rate. All other coefficient estimates are similar.

<sup>25</sup> The IFS provides a series called the “average cost of funds” starting in 1975, but this series did not have good fits in the regression equations. The treasury bill rate is available starting in 1978, and had better fits in the regression equations. Besides, the latter rate is a good proxy for monetary policy in Mexico, and is therefore more likely to be exogenous in an investment equation than a longer-term, bond-market rate.

<sup>26</sup> The null can be rejected at the 1% level for the two growth rates, but only at the 10% level for FinInflows ( $p$ -value of 0.055) and RealPesoDollar ( $p$ -value of 0.098). Augmented Dickey-Fuller tests were not used because they have low power to reject the null of a unit root in short samples. Results of all unit root tests are available on request.

<sup>27</sup> We use the term “long-run” here in its standard sense in time-series econometrics, i.e., the period in which the lagged effects of an independent variable work themselves out and the dependent variable adjusts to its new equilibrium level, following a shock to an independent variable. This period, which is on the order of a few years in the models in this paper, is not as long as the “long run” contemplated in growth theory, which is on the order of decades or longer. Thus, our use of the term “long-run” in relation to the econometric results is not intended to deny the essentially short-run nature of the present analysis.

<sup>28</sup> Similar tests for a break in the late 1980s at the time of Mexico’s internal reforms and initial trade liberalization could not be conducted due to the small number of observations for the pre-reform subsample.

<sup>29</sup> Although the choice of any particular year as the beginning of the liberalization period is inevitably arbitrary, 1988 was chosen for several reasons. First, it was around the middle of the period 1986–1990 when many of the most drastic liberalization measures were taken, starting from Mexico joining GATT in 1986 and culminating with the privatization of state-owned banks in 1990. Second, one of the most definitive studies of Mexico’s reforms cites 1988 as the year in which the government began to have success in reducing inflation, adopted a series of important banking reform measures, and “consolidated” its efforts at trade liberalization (see Lustig, 1998, pp. 51, 108, 117).

<sup>30</sup> We also tested using DLiberal and DNAFTA as intercept dummies in the growth equations. The results, which are available on request, show that both of these intercept dummies are generally insignificant, and that their signs and magnitudes are highly sensitive to which other variables (i.e., interactive terms) are included.

<sup>31</sup> In all the regressions shown in Table 2, the coefficient on the plain variable is an estimate of the effect *before* the structural break, while the coefficient on the interactive variable is an estimate of the *change* in the coefficient after the break (hence, the  $p$ -value for the interactive dummy shows the significance level of the break). A similar test using DLiberal\*USGrowth also finds a significant structural break, but only at the 10% level ( $p$ -value 0.069).

<sup>32</sup> Due to the small sample size, each interactive dummy term was tested separately (in addition to the DNAFTA\*USGrowth variable). Equations using more interactive dummies at once generally had severely autocorrelated residuals and other statistical problems.

<sup>33</sup> The coefficient for FinInflows for 1988–2006 is 0.635 with a standard error of 0.108 ( $p$ -value 0.000); the coefficient for RealOil for 1988–2006 is 0.026 with a standard error of 0.008 ( $p$ -value 0.004).

<sup>34</sup> It was decided not to focus on private investment due to the tremendous shift in the composition of total fixed capital formation from the public to the private sector during our sample period. The share of private investment rose from 57.0% of the total in 1980 to 82.9% in 2006 (INEGI data from Moreno-Brid & Ros, 2009, Table 8.1), and we did not want to confuse the determinants of total investment with the causes of this compositional shift.

<sup>35</sup> FDI includes acquisitions of significant shares of existing enterprises by foreign investors, and hence the degree to which it actually contributes to capital formation is uncertain *a priori*. In Mexico, some of the largest FDI inflows have been for acquisitions rather than greenfield investment.

<sup>36</sup> Also, the large inflationary shocks of the 1980s led to volatile swings in the real interest rate (see Figure 6) that may not have had predictable effects on investment expenditures.

<sup>37</sup> This specification essentially assumes that the growth rate and change in the real interest rate affect the desired capital stock based on adaptive expectations, whereas the other variables affect the financing of investment flows in

the short run (see Chirinko et al., 1999, on the distinction between variables that affect desired capital stocks and variables that affect financial or “liquidity” constraints).

<sup>38</sup> We also tried investment equations including a lagged dependent variable along with distributed lags of the independent variables, i.e., an autoregressive distributed lag (ARDL) model. The results, which are available on request, yield qualitatively similar results to equations (3.4) through (3.6) in Table 3, except that RealOil becomes insignificant, the lags of MexGrowth also become insignificant, and the FDI-GDP ratio is insignificant when included. The ARDL specification does not solve the problem of significant RESET tests for equation misspecification (the cubed residuals are significant at the 5% level), and exhibits very large residuals during the debt crisis years of the 1980s (perhaps because lagged InvRate is not a good predictor of current InvRate during that volatile period).

<sup>39</sup> The DOLS procedure is really just a special application of OLS, and hence all the statements about OLS here also apply to the DOLS estimates.

<sup>40</sup> The Breusch-Pagan LM test statistic is

$$\lambda = n \sum_{i=2}^m \sum_{j=1}^{i-1} \rho_{ij}^2,$$

where  $n$  is the number of observations,  $m$  is the number of equations,  $\rho_{ij}$  is the correlation coefficient between the residuals of the  $i^{th}$  and  $j^{th}$  equations, and (under the null hypothesis of no cross-equation correlation)  $\lambda$  is distributed as a  $\chi^2[0.5m(m-1)]$ . With two equations ( $m = 2$ ), this statistic reduces to  $\lambda = n\rho^2$ , where  $\rho$  is the correlation of the residuals from the two equations, and  $\lambda \sim \chi^2(1)$ .

<sup>41</sup> Equation (1.2) from Table 1 was omitted because the RESET tests indicated equation misspecification, and because RealPesoMulti was not used in any of the investment functions in Table 3. Otherwise, residuals from all possible combinations of equations from Tables 1 and 3 were tested and found to be uncorrelated.

<sup>42</sup> These tests were conducted using equation (1.4) for MexGrowth and (3.5) for InvRate, from Tables 1 and 3, respectively (except, when testing for exogeneity of InvRate in the MexGrowth equation, we added the level and first difference of InvRate into equation 1.4). In the first stage regression, the RHS variable whose exogeneity is being tested is regressed on all the exogenous variables in the equation plus additional instruments for the variable in question, and the residuals are saved. For InvRate, the instruments we used were 0 to 2 lags of MexGrowth and contemporaneous  $\Delta$ RealInterest; for MexGrowth, the instruments were FinInflows, DNAFTA\*USGrowth, and lagged RealPesoDollar (RealOil is already included in the equation). Then, in the second-stage regression, the original equation is re-run with the first-stage residuals included as a regressor, and the null hypothesis is that the residuals are insignificant (implying weak exogeneity). Details of these regressions are available on request.

<sup>43</sup> Hypothesis tests for the Hausman procedure are conducted using the standard normal distribution. For the MexGrowth residuals in the InvRate equation, the  $t$ -statistic is 1.27, which is less than the 2-sided 10% critical value of 1.64 (so the null is accepted). For the InvRate residuals in the MexGrowth equation, the absolute value of the  $t$ -statistic is 2.68, which is greater than the 2-sided 1% critical value of 2.58 (thus, the null is rejected).

<sup>44</sup> Results of these Breusch-Pagan tests are not given here for reasons of space, but are available on request.

<sup>45</sup> Equation (1.4), which is the same as (2.2), is preferred to equation (2.3) or (2.4) because of the serially correlated residuals in the latter two. Also, since adding InvRate as a regressor takes away an additional degrees of freedom from a model with a small sample size, it is desirable to use a baseline model with fewer other regressors.

<sup>46</sup> The differenced variables cannot be used as instruments in the 2SLS estimation because they are endogenous; therefore, lagged values of the variables were used as instruments instead. This resulted in a large number of endogenous variables relative to the sample size, which in turn led to very large standard errors and insignificant coefficients on most of the RHS variables.

<sup>47</sup> Although we do not use equation (2.3), which allows for a structural break in the effects of net financial inflows, the coefficient on FinInflows in equation (2.4) is 0.545, which is less than the coefficient on this variable for the post-liberalization period implied by equation (2.3) (which would be  $1.101 - 0.466 = 0.635$ ). Thus, the estimates reported here for the effects of net financial inflows are conservative.

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Table 1. *DOLS estimates of growth equations*

Dependent variable: MexGrowth(t); Sample period: 1980-2006 (27 annual observations)

Equation:	(1.1)	(1.2)	(1.3)	(1.4)
Constant	-4.817 (0.092)	3.197 (0.163)	6.050 (0.105)	8.704 (0.003)
FinInflows(t)	0.640 (0.006)	0.716 (0.002)	0.850 (0.000)	0.678 (0.001)
$\Delta$ FinInflows(t)	0.214 (0.118)	-0.013 (0.917)	-0.082 (0.544)	-0.017 (0.908)
RealOil(t)	0.025 (0.061)	0.038 (0.000)	0.035 (0.007)	0.042 (0.002)
$\Delta$ RealOil(t)	0.042 (0.125)	0.046 (0.005)	0.052 (0.015)	0.032 (0.206)
USGrowth(t)	0.821 (0.030)	0.617 (0.003)	0.402 (0.220)	0.530 <sup>a</sup> (0.024)
$\Delta$ USgrowth(t)	-0.397 (0.049)	-0.196 (0.309)	-0.098 (0.702)	0.711 <sup>a</sup> (0.176)
RealPeso(t-1) <sup>b</sup>		-0.110 (0.001)	-0.132 (0.003)	-0.158 (0.001)
$\Delta$ RealPeso(t-1) <sup>b</sup>		0.063 (0.047)	0.083 (0.089)	0.118 (0.000)
$R^2$	0.686	0.816	0.790	0.858
Adjusted $R^2$	0.592	0.734	0.697	0.795
SE	2.198	1.774	1.896	1.559
SSR	96.60	56.67	64.71	43.75
Durbin-Watson	1.876	2.461	2.150	2.019
<u>Diagnostic tests (<i>p</i>-values):</u>				
Jarque-Bera Normality	0.522	0.525	0.938	0.873
Breusch-Godfrey LM test (2 lags)	0.578	0.348	0.420	0.821
RESET (squared fitted values)	0.608	0.045	0.407	0.537
RESET (cubed fitted values)	0.118	0.007	0.341	0.751
Chow Breakpoint (F-statistic) <sup>c</sup>	0.039	0.174	0.024	
Chow Breakpoint (likelihood ratio) <sup>c</sup>	0.001	0.001	0.000	

Notes: Numbers in parentheses are *p*-values (significance levels) using Newey-West adjusted standard errors. Equations were estimated using dynamic ordinary least squares (DOLS); coefficients on the levels of the independent variables measure long-run effects.

<sup>a</sup>In equation (1.4) this variable is interacted with DNAFTA, which is 1 in 1994-2006 and 0 otherwise.

<sup>b</sup>Measured by RealPesoMulti in equation (1.2) and RealPesoDollar in (1.3) and (1.4).

<sup>c</sup>Tests were performed for a break in the first year of NAFTA (1994). Tests for a liberalization break starting in the late 1980s could not be performed due to insufficient observations for earlier years. This test cannot be calculated for equation (1.4) due to the inclusion of the interactive NAFTA dummy.

Table 2. *Tests for structural change in growth equations (long-run coefficients)*  
Dependent variable: MexGrowth(t); Sample period: 1980-2006 (27 annual observations)

Equation:	(2.1)	(2.2)	(2.3)	(2.4)	(2.5)	(2.6)
FinInflows(t)	0.649 (0.002)	0.678 (0.001)	1.101 (0.000)	0.545 (0.003)	0.661 (0.002)	0.533 (0.033)
DLiberal(t)*FinInflows(t)			-0.466 (0.000)			
RealOil(t)	0.042 (0.003)	0.042 (0.002)	0.026 (0.003)	0.042 (0.000)	0.029 (0.016)	0.036 (0.005)
DLiberal(t)*RealOil(t)				-0.016 (0.015)		
USGrowth(t)	-0.099 (0.638)					
DNAFTA(t)*USGrowth(t)	0.574 (0.013)	0.530 (0.024)	0.555 (0.001)	0.714 (0.003)	0.623 (0.014)	0.982 (0.022)
RealPesoDollar(t-1)	-0.162 (0.002)	-0.158 (0.001)	-0.168 (0.000)	-0.120 (0.007)	-0.126 (0.026)	-0.103 (0.120)
DLiberal(t)*RealPesoDollar(t-1)					-0.020 (0.131)	
DNAFTA(t)*RealPesoDollar(t-1)						-0.023 (0.153)
$R^2$	0.859	0.858	0.892	0.902	0.870	0.866
Adjusted $R^2$	0.770	0.795	0.825	0.841	0.789	0.782
SE	1.650	1.559	1.442	1.373	1.580	1.608
SSR	43.56	43.75	33.27	30.16	39.96	41.38
Durbin-Watson	2.041	2.019	2.634	2.466	2.236	2.329
<u>Diagnostic tests (<math>p</math>-values)</u>						
Jarque-Bera Normality	0.884	0.873	0.850	0.716	0.807	0.883
Breusch-Godfrey LM test (2 lags)	0.834	0.821	0.120 <sup>a</sup>	0.197 <sup>b</sup>	0.701	0.536
RESET (squared fitted values)	0.454	0.537	0.128	0.207	0.639	0.385
RESET (cubed fitted values)	0.640	0.751	0.311	0.451	0.878	0.659

Notes: Numbers in parentheses are  $p$ -values. A constant and first differences of all independent variables were also included in each regression. DLiberal is 1 in 1988-2006 and 0 otherwise; DNAFTA is 1 in 1994-2006 and 0 otherwise.

<sup>a</sup>For 1 lag, the  $p$ -value is .044, indicating significant serial correlation.

<sup>b</sup>For 3 lags, the  $p$ -value is .079, indicating significant serial correlation.

Table 3. *Estimated investment functions (long-run coefficients)*  
Dependent variable: InvRate(t); Sample period: 1981-2006 (26 annual observations)

Equation:	(3.1)	(3.2)	(3.3)	(3.4)	(3.5)	(3.6)
Constant	4.204 (0.016)	5.098 (0.001)	4.730 (0.005)	6.876 (0.000)	7.122 (0.000)	7.292 (0.000)
MexGrowth	0.576 (0.001)	0.676 (0.000)	0.680 (0.000)	0.563 (0.000)	0.586 (0.000)	0.626 (0.000)
DLiberal*ΔRealInterest	-0.041 <sup>a</sup> (0.231)	-0.089 (0.001)	-0.085 (0.000)	-0.015 <sup>a</sup> (0.202)	-0.025 (0.065)	-0.025 (0.044)
RealPesoDollar	0.118 (0.000)	0.106 (0.000)	0.101 (0.000)	0.091 (0.000)	0.088 (0.000)	0.076 (0.000)
RealOil	0.021 (0.000)	0.020 (0.000)	0.024 (0.000)	0.017 (0.001)	0.018 (0.002)	0.019 (0.000)
FDI-GDP Ratio			0.219 (0.098)			0.248 (0.083)
$R^2$	0.971	0.978	0.982	0.929	0.929	0.935
Adjusted $R^2$	0.945	0.959	0.959	0.903	0.903	0.906
SE	0.660	0.570	0.567	0.907	0.907	0.895
SSR	5.656	4.223	3.536	15.635	15.635	14.432
Durbin-Watson	1.239	1.408	1.657	1.667	1.605	1.797
<u>Diagnostic tests (<math>p</math>-values):</u>						
Jarque-Bera Normality	0.818	0.266	0.248	0.662	0.686	0.859
Breusch-Godfrey LM test (2 lags)	0.123 <sup>b</sup>	0.212 <sup>c</sup>	0.532	0.444	0.355	0.083
RESET (squared fitted values)	0.188	0.307	0.322	0.609	0.457	0.587
RESET (cubed fitted values)	0.001	0.001	0.000	0.093	0.067	0.067

Notes: Numbers in parentheses are  $p$ -values (significance levels) using Newey-West adjusted standard errors. Equations (3.1) to (3.3) were estimated using DOLS; differences of the variables were also included but are not shown here (see text for details). Equations (3.4) to (3.6) were estimated using OLS with distributed lags; coefficients shown for MexGrowth are the sums for 0 to 2 lags and coefficients shown for DLiberal\*ΔRealinterest are the sums for 0 and 1 lag (with  $p$ -values based on  $F$ -tests).

<sup>a</sup>The interactive dummy variable DLiberal (for the liberalization period 1988–2006) is omitted in this equation.

<sup>b</sup>For 1 and 3 lags, the  $p$ -values are .041 and 0.039, respectively, indicating significant serial correlation.

<sup>c</sup>For 1 lag, the  $p$ -value is .080, indicating significant serial correlation.

Table 4. *Two-stage least squares (2SLS) estimates of simultaneous equations models*  
Sample period: 1980-2006 (27 annual observations)

Equation:	(4.1a)	(4.1b)	(4.2a)	(4.2b)
Dependent Variable:	MexGrowth	InvRate	MexGrowth	InvRate
Constant	1.351 (0.731)	6.479 (0.000)	0.054 (0.989)	6.862 (0.000)
FinInflows(t)	0.550 (0.019)		0.473 (0.033)	
RealOil(t)	0.021 (0.248)	0.018 (0.001)	0.015 (0.387)	0.021 (0.000)
DNAFTA(t)*USGrowth(t)	0.502 (0.036)		0.460 (0.046)	
RealPesoDollar(t)		0.097 (0.000)		0.077 (0.001)
RealPesoDollar(t-1)	-0.162 (0.000)		-0.171 (0.000)	
InvRate(t)	0.571 (0.188)		0.740 (0.073)	
MexGrowth (sum of t, t-1, t-2) <sup>a</sup>		0.505 (0.000)		0.583 (0.000)
DLiberal*ΔRealInterest (sum of t, t-1) <sup>a</sup>		-0.023 (0.310)		-0.023 (0.299)
FDI-GDP Ratio(t) <sup>b</sup>				0.392 (0.119)
$R^2$	0.788	0.925	0.800	0.930
Adjusted $R^2$	0.738	0.898	0.753	0.899
SE	1.763	0.931	1.712	0.925
SSR	65.268	16.45	61.531	15.397
Jarque-Bera Normality <sup>c</sup>	0.971	0.468	0.986	0.746

Notes: Numbers in parentheses are  $p$ -values (significance levels). Each pair of equations (4.1 and 4.2) was estimated using 2SLS; all exogenous and predetermined variables in both equations were used as instruments (i.e., all variables except InvRate(t), MexGrowth(t), and FDI-GDP Ratio (t)).

<sup>a</sup>Wald tests were used to calculate  $p$ -values based on chi-square statistics for sums of coefficients.

<sup>b</sup>Treated as an endogenous variable; the lagged FDI-GDP Ratio (t-1) was used as an additional instrument in equations (4.2a-b).

<sup>c</sup>This is the  $p$ -value for the null hypothesis of multivariate normality, using the Lutkepohl orthogonalization method (Cholesky of covariance).

Table 5. *Simulated Effects*

	Growth Rate				Investment Rate				
	One standard		Eq. 2.2		Growth		Eq. 3.6		Investment
<u>Sample period 1979-2006<sup>a</sup></u>	<u>deviation change</u>	×	<u>LR Coeff.</u>	=	<u>effect</u>	×	<u>LR Coeff.</u>	=	<u>effect</u>
Net financial inflows	3.387		0.678		2.297		0.626		1.437
U.S. growth rate (1994-2006)	1.124		0.530		0.596		0.626		0.373
Real oil price - effect on growth	42.790		0.042		1.810		0.626		1.133
direct effect on investment							0.019		0.833
total (net) effect on investment									1.965
Real dollar-peso index - effect on growth	14.718		-0.158		-2.325		0.626		-1.455
direct effect on investment							0.076		1.124
total (net) effect on investment									-0.331
Real interest rate (1988-2006)	13.115						-0.025		-0.326
FDI-GDP ratio	1.046						0.248		0.259
	Change in		Eq. 2.4		Growth		Eq. 3.6		Investment
<u>Changes from 1996-2000 to 2001-2006<sup>b</sup></u>	<u>variable</u>	×	<u>LR Coeff.</u>	=	<u>effect</u>	×	<u>LR Coeff.</u>	=	<u>effect</u>
Net financial inflows	-1.072		0.545		-0.585		0.626		-0.366
U.S. growth rate	-1.690		0.714		-1.206		0.626		-0.755
Real oil price - effect on growth	49.652		0.026		1.299		0.626		0.813
direct effect on investment							0.019		0.966
total (net) effect on investment									1.779
Real dollar-peso index - effect on growth	10.503		-0.120		-1.262		0.626		-0.790
direct effect on investment							0.076		0.802
total (net) effect on investment									0.013
Real interest rate	0.148						-0.025		-0.004
FDI-GDP ratio	0.112						0.248		0.028

Source: Author's calculations.

Notes: "LR" means long-run.

<sup>a</sup>Except as indicated, where other years were used due to structural breaks.<sup>b</sup>Difference between the averages for each period.

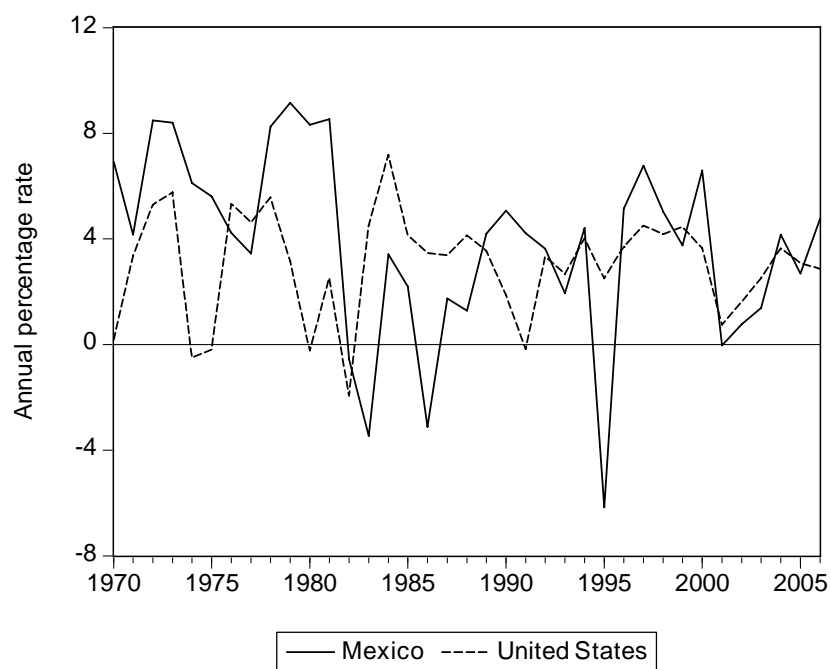


Figure 1. *Mexican and U.S. growth rates of real GDP, 1970-2006. Source: International Monetary Fund (IMF), International Financial Statistics (IFS).*

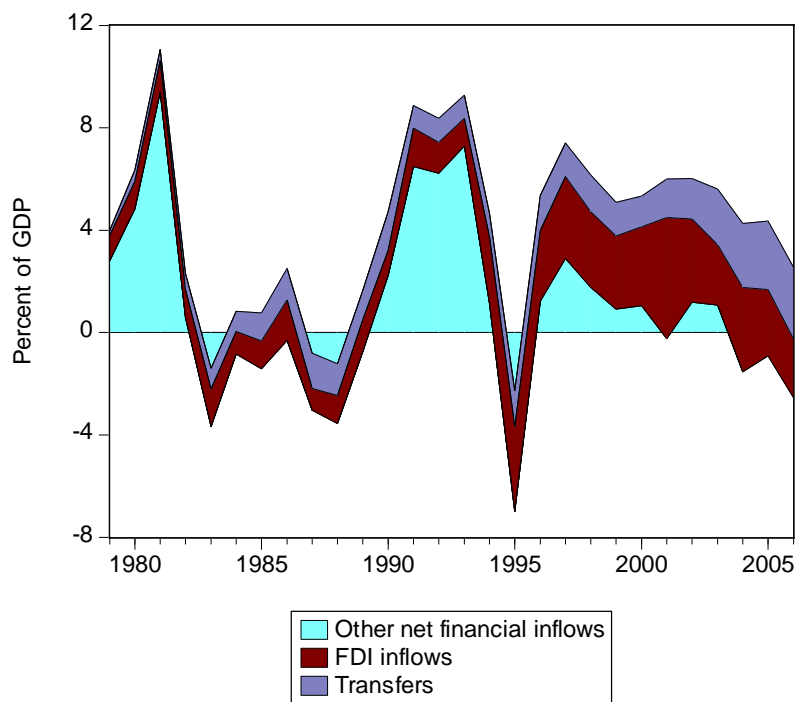


Figure 2. *Net financial inflows and their composition, as percentages of GDP, 1979-2006. Sources: IMF, IFS; and author's calculations*



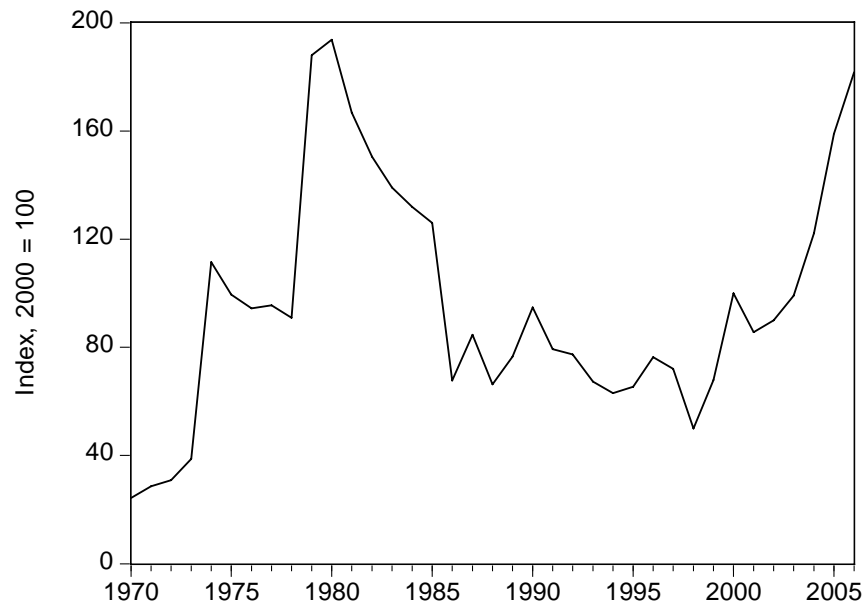


Figure 3. *World real oil price index, 1970-2006. Sources: IMF, IFS; and author's calculations.*

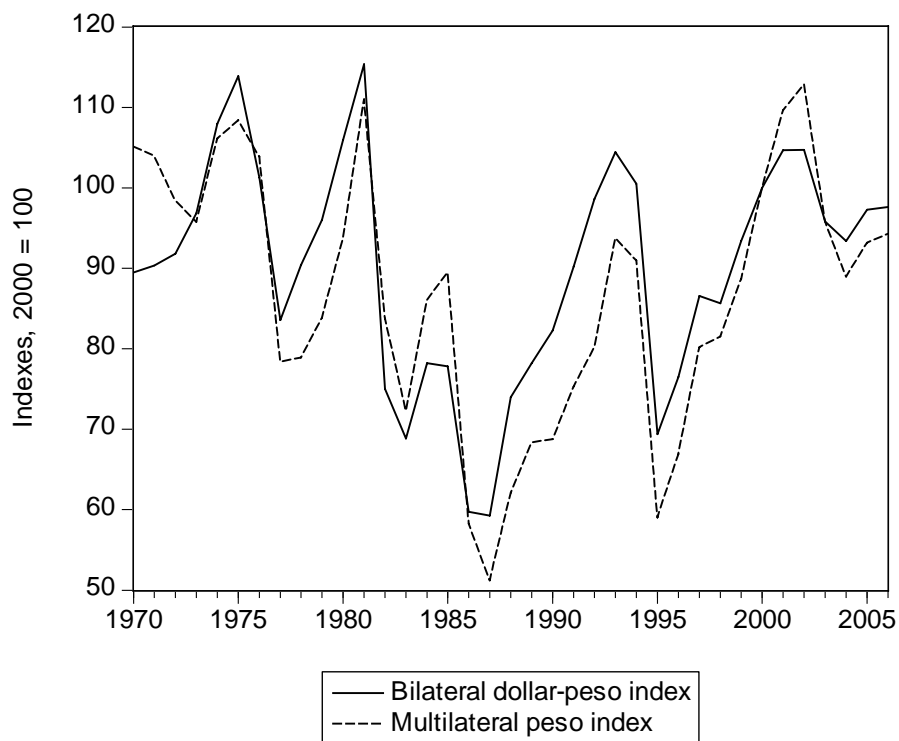


Figure 4. *Indexes of the real value of the peso, 1970-2006. Source: Banco de México ([www.banxico.gob.mx](http://www.banxico.gob.mx)); IMF, IFS; and author's calculations.*

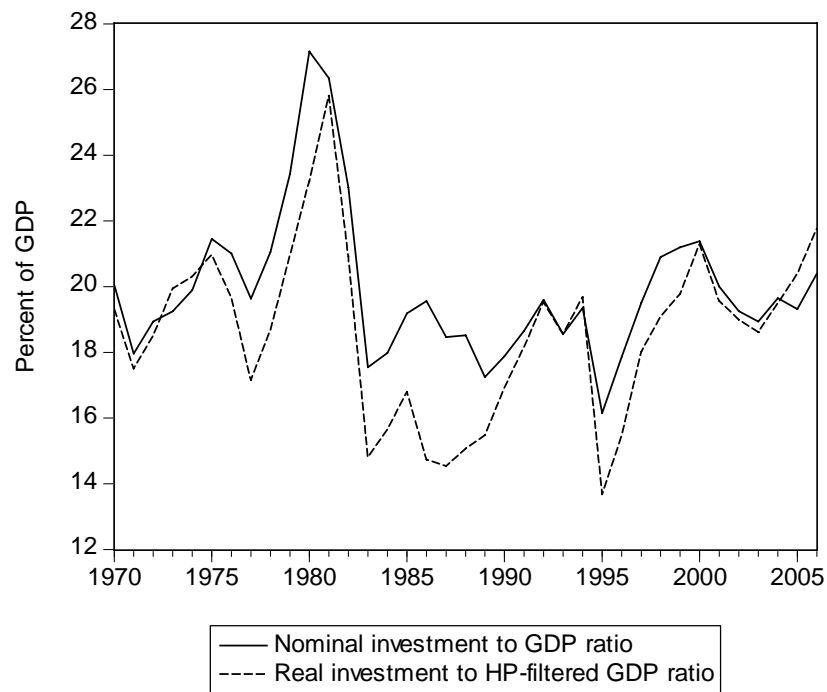


Figure 5. *Nominal and real investment rates, 1970-2006. Sources: INEGI ([www.inegi.gob.mx](http://www.inegi.gob.mx)); and author's calculations.*

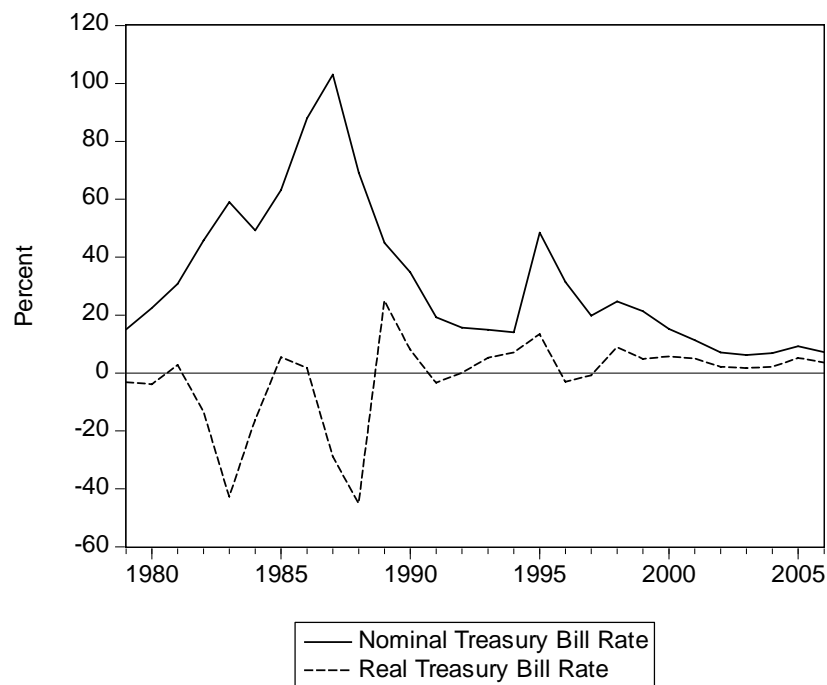


Figure 6. *Nominal and real treasury bill interest rates, 1979-2006. Sources: IMF, IFS; and author's calculations.*